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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	)	
Alexander Schnell et al.	)	Group Art Unit: 1742
Application No.: 10/726,608	)	Examiner: SCOTT R KASTLER
Filed: December 4, 2003	)	Confirmation No.: 6934
For: NON-DESTRUCTIVE TESTING METHOD OF DETERMINING THE SERVICE METAL TEMPERATURE OF A COATING	)	

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DECLARATION BY ALEXANDER SCHNELL UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Alexander Schnell, hereby state the following:

1. I am one of the named co-inventors in the above-identified application ("the present application").

2. As indicated in my attached curriculum vitae, I earned a PhD from the University of Lausanne EPFL. I have been employed in the technical area of turbomachinery at ABB and Alstom since 1988. I have also co-authored published technical papers and received European patents related to the field of turbomachinery, including gas turbine materials and processes.

3. Current claim 1 of the present application is directed to a method of determining the service metal temperature of a γ/γ' MCrAlY-coated component after the component has been used in a high temperature environment. The γ/γ'-MCrAlY-

coating of the component exhibits a non-equilibrium γ/γ'-microstructure at a temperature lower than the temperature during operation and the depletion of chromium from the γ/γ'-MCrAlY-coating still allows the α-Cr phase to form. The claimed method comprises, *inter alia*, "(a) measuring qualitatively impedance curves or measuring the coating electrical conductivity and magnetic permeability of the non-equilibrium MCrAlY-coating of the component in the post-service condition at different locations of the component by means of a multi-frequency eddy current system" and "(b) then <u>subjecting the coated component to a heat treatment</u> to transform the non-equilibrium MCrAlY coating into an equilibrium microstructure of the coating" (emphasis added). The method recited in claim 1 further comprises "(c) then measuring qualitatively impedance curves or measuring the electrical conductivity and magnetic permeability of the equilibrium MCrAlY- coating at different locations of the component by means of a multi-frequency eddy current system" and "(d) determining the exposure temperature of the different locations of the component based on the difference in the measured impedance curves or the measured conductivities and permeabilities, before and after the heat treatment according to (b)." As discussed below, the "heat treatment" recited in claim 1, clause (b), is different from the "standard heat treatment" described in the present application.

4. Upon information and belief: Components, e.g., blades and vanes, used in the hot gas path of turbines can be made from nickel-based superalloys. During the manufacturing of these components, a sequence of heat treatments is performed in order to fully exploit the mechanical properties of the nickel-based

superalloys. Each type of superalloy used for these components requires a specific heat treatment, which is typically recommended by the alloy supplier. In most cases, the specific heat treatment for a superalloy includes several individual heat treatment steps. For example, the heat treatment may include the following steps: (a) solution heat treatment (typically at a temperature of ~1180°C - 1290°C); (b) first precipitation step (typically at ~ 1080°C - 1160°C); and (c) second precipitation step (typically at ~ 850°C-870°C).

5. Upon information and belief: In the gas turbine industry, the term "standard heat treatment" commonly refers to heat treatments that are applied to specific superalloys. In this usage in the gas turbine art, the term "standard" means a heat treatment that is associated with a particular superalloy composition.

6. Upon on information and belief: Gas turbine components require a protective coating. After a protective coating has been applied to a given gas turbine component, the coated component is then heat treated in order to properly bond the coating to the underlying parent superalloy material. The as-coated component is given a "standard heat treatment." Accordingly, the specific conditions of the heat treatment of the as-coated component depend on the particular parent superalloy material.

7. At page 5, lines 19-21, of the present application, it is described that "after the <u>standard heat treatment</u> (1120°C/2h + 870°C/20) the SV20 coating shows a microstructure consisting of a γ-Ni matrix with the Al rich γ' phase and Cr-rich α-Cr

phase" (emphasis added). A "standard heat treatment" is also described at page 7, lines 7-8, of the present application, with regard to SV20/MarM247.

8. Upon information and belief: The term "standard heat treatment" described at page 5, line 19; and page 7, lines 7-8, of the present application, pertains to the standard heat treatment used for the parent superalloy material on which the coating is applied, not to a heat treatment for the coating. There exists no standard heat treatment for the MCrAlY coating itself. This statement applies to all sprayed MCrAlY coatings used on blades and vanes in the hot gas path of turbines. Accordingly, the term "standard heat treatment" is not relevant to the MCrAlY coatings. As explained at point (6) above, after a gas turbine component has been coated, the as-coated component is heat treated. The heat treatment applied to the coated component is the standard heat treatment (first and second precipitation steps) that is designed for the parent base material. Basically, two heat treatments, i.e., a coating diffusion heat treatment (which in most cases is the first precipitation step for the superalloy, as discussed above at point (4)) + a standard heat treatment for the parent base material, are merged. Consequently, because the standard heat treatment depends on the particular parent superalloy material that is coated, the heat treatment conditions for the merged heat treatments that are applied to as-coated gas turbine components will change for components made from different parent superalloy materials.

9. Upon information and belief: After a gas turbine component has been used in a high temperature environment (i.e., the component is in an "ex-service

condition"), the "ex-service" gas turbine component can be evaluated to determine the service metal temperature of the component using a multi-frequency eddy current system ("the FSECT technique"), as described at page 7, line 15, to page 8, line 5, of the present application.

10. Upon information and belief: Typically, with regard to information backflow and performance of an ex-service component, one skilled in the art would not subject an ex-service component to a heat treatment because this heat treatment would, in effect, blur or distort the information that is stored in the component's microstructure.

11. Upon information and belief: The present inventors determined that, in order to be able to properly apply the FSECT technique to a γ/γ′ MCrAlY-coated component that has been used in a high temperature environment (i.e., to apply the FSECT technique to obtain a reliable assessment of the γ/γ′ MCrAlY coating), the component needs to be heat treated according to the step recited in claim 1, clause (b). The present inventors determined that subjecting an ex-service γ/γ′ MCrAlY-coated component to the claimed heat treatment unexpectedly provides a solution to the unreliable coating assessment problems associated with the FSECT technique.

12. Upon information and belief: The heat treatment recited in claim 1, clause (b), is different from a "standard heat treatment" that is applied during the manufacturing of gas turbine components to produce new components (i.e., components that have not been used in service). The heat treatment recited in claim

1, clause (b), is performed for the purpose of determining information about the physical properties of the coating at different locations of the component. However, as explained above, there exists no "standard" heat treatment for coatings. Consequently, it would not have been obvious to one skilled in the art to apply a heat treatment to a γ/γ′ MCrAlY coating of a component, with the coating in the ex-service condition, much less the heat treatment recited in claim 1, clause (b).

13. In the Advisory Action dated January 13, 2006, in the present application, the Examiner states that "the purpose of the heat treatment recited by the admitted prior art of the insta t [sic] disclosure (to transform non-equilibrium MCrAly) [sic] is the same as the effect desire by both of the Antonelli references."

14. Upon information and belief: The standard heat treatments described at page 5, line 19, and at page 7, lines 7-8, of the present application, are applied to the as-coated component to fully exploit the mechanical properties of the parent superalloy material. There are heat treatments known for the reconditioning of ex-service components in order to restore the mechanical properties of the ex-service components, i.e., the microstructure of the components. These heat treatments are not, however, performed for the same purpose as the heat treatment recited in claim 1, clause (b), which is to overcome the unreliable coating assessment problem associated with using the FSECT technique.

15. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: February 21, 2006 By: Alexander Schnell
Alexander Schnell